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TITLE: Composite capillary tube structure and method of forming

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INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Jaeger; Raymond E.	Sturbridge	MA		
Asrami; Mohd	Sturbridge	MA		

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CLAIMS:

We claim:
1. A composite capillary tube structure made of a plurality of glass layers comprising:
inner and outer layers of a first glass material separated by an intermediate layer of a second glass material having a higher coefficient of thermal expansion than that of said first glass material, so that the inner and outer layers are maintained under a compressive force over a temperature range of up to about 400.degree. C.
2. The composite capillary tube structure of claim 1 wherein the second glass material has a glass transition temperature between 500.degree. C. and the T.sub.g of said first glass material.
3. The composite capillary tube structure of claim 2 wherein the glass transition temperature of the second glass material is as close as possible to that of said first glass material.
4. The capillary tube structure of claim 1 wherein the outer layer is fused silica.
5. The tube structures of claim 1 wherein the intermediate layer is a borosilicate or aluminosilicate glass.
6. A composite capillary tube structure made of a plurality of glass layers comprising inner and outer layers of fused silica glass separated by an intermediate layer of a glass material having a higher coefficient of thermal expansion than said fused silica glass, said glass material also having a glass transition temperature on the same order as that of fused silica, so that the fused silica layers are maintained under compressive forces over a temperature range of up to about 400.degree. C.
7. The capillary tube structure of claim 6 wherein the intermediate layer is a borosilicate or aluminosilicate glass.
8. A method of making a composite capillary tube structure having a plurality of glass layers, which method comprises:
forming a preform of a concentric tube comprising inner and outer layers of a first glass material separated by an intermediate layer of a second glass material having a higher coefficient of thermal expansion than that of said first glass material;
heating said preform to a sufficient temperature to soften the glass materials;
drawing a composite capillary tube structure from said heated preform; and
cooling said tube structure to develop stresses between said layers, so that the inner and outer layers are maintained under compressive force over a temperature range of up to about 400 C.

9. The method of claim 8 which further comprises selecting said intermediate layer having a glass transition temperature which is within about 100 degrees of that of said inner and outer layers.
10. The method of claim 8 which further comprises selecting said inner and outer layers of fused silica.
11. The method of claim 8 which further comprises selecting said intermediate layer of a borosilicate or aluminosilicate glass.
12. A method of making a composite capillary tube structure having a plurality of glass layers, which method comprises:
forming a preform of a concentric tube comprising inner and outer layers of fused silica separated by an intermediate layer of a glass material having a higher thermal expansion coefficient than that of fused silica;
heating said preform to a sufficient temperature to soften the glass materials;
drawing a composite capillary tube structure having said layers bonded together from said heated form; and
cooling said tube structure to develop stresses between said layers, so that the inner and outer fused silica layers are maintained under a compressive force over a temperature range of up to about 400.degree. C.
13. The method of claim 12 which further comprises selecting said intermediate layer of a borosilicate or aluminosilicate glass.
14. The composite capillary tube structure produced by the method of claim 8.
15. The composite capillary tube structure produced by the method of claim 12.
16. The composite capillary tube structure produced by the method of claim 13.